

HATCHERY EVALUATION REPORT

Willard NFH - Coho

February 1997

Integrated Hatchery Operations Team (IHOT)

HATCHERY EVALUATION REPORT

Willard NFH - Coho

An Independent Audit Based on Integrated Hatchery Operations Team (IHOT) Performance Measures

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Executive Summary

This report presents the findings of the independent audit of the Willard NFH - Coho program. The hatchery is located on the Little White Salmon River approximately 4 miles upstream from the Little White Salmon NFH. The two hatcheries are operated as a single complex. The hatchery is used for incubation and rearing of coho.

The audit was conducted in 1996-1997 as part of a 2-year effort that will include 67 hatcheries and satellite facilities located on the Columbia and Snake River system in Idaho, Oregon, and Washington. The hatchery operating agencies include the U.S Fish and Wildlife Service, Idaho Department of Fish and Game, Oregon Department of Fish and Wildlife, and Washington Department of Fish and Wildlife.

Background

The audit is being conducted as a requirement of the Northwest Power Planning Council (NPPC) "Strategy for Salmon" and the Columbia River Basin Fish and Wildlife Program. Under the audit, the hatcheries are evaluated against policies and related performance measures developed by the Integrated Hatchery Operations Team (IHOT). IHOT is a multi-agency group established by the NPPC to direct the development of new basinwide standards for managing and operating fish hatcheries. The Bonneville Power Administration (BPA) contracted with Montgomery Watson to act as an independent contractor for the audit.

IHOT has established five basic policies that cover: (1) hatchery coordination, (2) hatchery performance standards, (3) fish health, (4) ecological interaction, and (5) genetics. The audit focuses on all these policies, with the exception of hatchery coordination. These policies are set forth in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries (IHOT 1995)*. That document is the source for the performance measures that are the basis of this audit.

The Audit Process

The audit was based on the facility management's response to a 109-page questionnaire. This audit form was completed through a five-step process in which:

- Information was obtained from headquarters.
- The hatchery manager was asked to fill out and return the audit form.
- A 1-2 day site audit visit was conducted to inspect facilities, review hatchery records, discuss audit form responses, and develop remedial action plans.
- A compliance report was developed to document the compliance status of each performance measure. This report was then shared with the hatchery manager and IHOT representative.
- This hatchery evaluation report was written to document compliance with IHOT performance measures and develop cost estimates for remedial actions when needed.

Willard NFH - Coho Results

The Willard facility includes 50 concrete raceways, 52 starter tanks, and incubation facilities (Carson Depot Springs). Willard NFH was authorized by the Mitchell Act in 1946 and constructed in 1952. The facility was originally planned as a fall chinook hatchery but was switched to spring chinook and coho because of cold water temperatures, and then switched completely to coho in the mid-1960s. The goal of the hatchery is to provide fish to the commercial, sport, and tribal fisheries.

The Willard NFH - Coho program was in general compliance with most of the performance measures. In the area of program objectives, the was not meeting its adult return or fry-to-smolt goals . The audit found that the hatchery was not in compliance with water quality monitoring requirements, pathology-free water criteria, alarm protocols, and predation control facility criteria, which are all facilities requirements. The hatchery was not meeting the IHOT incubation criteria for loading and flow and needed additional nursery tanks to meet the density criteria for early rearing. The hatchery did not have a Genetics Monitoring and Evaluation Program.

The specific areas in which the Willard NFH - Coho program requires remedial actions based on the IHOT performance measures are listed below. These remedial actions are listed in alphabetical order without intent of ranking or otherwise assigning priority:

- Develop approved genetics M&E plan
- Develop disease-free water supply for early rearing
- Develop smoltification goal and monitor
- Develop specific incubation and rearing standards for the IHOT Operations Plan
- Follow IHOT incubation flow criteria or revise criteria
- Follow IHOT protocols for checking of flow and other alarms
- Increase fry-to smolt survival
- Increase hardness of river water
- Install 1,100 ft of perimeter fencing and 41,700 sf of bird netting
- Install 40 additional nursery tanks

- Monitor DO and TGP and record
- Provide temperature control for rearing
- Run analysis for missing water chemistry parameters, turbidity, nitrite, and contaminants

Non-compliance issues resulting from items beyond human control or Performance Measures not relevant to this hatchery (Type 1 in Table 3, Section 4 of this report) were not listed above.

Facility Description

Name: Willard National Fish Hatchery

Stock/Species: Coho

Operating Agency: U.S. Fish and Wildlife Service

Funding Agency: Mitchell Act (NMFS)

Location: The hatchery is located on the Little White Salmon River
approximately 4 miles upstream from the Little White Salmon NFH.
The two hatcheries are operated as a single complex.

Address: 56961 SR 14
Cook, WA 98605

Hatchery Manager: Mr. Speros Doulos

Phone: (509) 538-27755

Fax:

Purpose: Willard NFH was authorized by the Mitchell Act in 1946 and
constructed in 1952. It began operations in 1952. The facility was
originally planned as a fall chinook hatchery but was switched to spring
chinook and coho because of cold water temperatures, and then
switched completely to coho in the mid-1960s. The goal of the
hatchery is to provide fish to the commercial, sport, and tribal fisheries.

Production Goal: Coho
Produce 2.5 million coho smolts (166,600 lb) for on-station release.

Water Supply:

Water use at the hatchery ranges from 11,221 to 24,442 gpm with most of the water supplied by the Little White Salmon River. Carson Depot Springs is located off station and used for incubation. Well water is used for incubation and temperature control during early rearing.

Facilities:

Adult Holding:	None
Incubation:	At Carson Depot Springs, see below under satellite facilities
Early Rearing:	52 concrete starter tanks - 91 cf each
Raceways:	50 concrete raceways - 1,408 cf each
Rearing Ponds:	None
Satellite Facilities:	Carson Depot Springs
	24 full stacks of vertical tray incubators (384 trays)

Compliance Status

The hatchery audits are based on compliance with written IHOT performance measures. These performance measures are documented in *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* (referred to as *IHOT 1995* in this report).

The purpose of the performance measures is to implement new basinwide policies that provide regional guidelines for operating anadromous hatcheries in the Columbia Basin.

The audit focuses on performance measures for IHOT policies that cover (1) hatchery performance standards, (2) fish health, (3) ecological interaction, and (4) genetics. These performance measures are intended to guide hatchery operations once production is established. For that reason, the hatchery operations audit included broodstock collection, spawning, incubation of eggs, fish rearing and feeding, fish release, equipment maintenance and operations, and personnel training. Production priorities are beyond the scope of this audit.

Based on *IHOT 1995*, a detailed 109-page audit form was developed. The audit form divided the performance measures into six major sections along major program and technical criteria areas. Two additional sections (sections 1 and 8) include general information and expenditure information needed for this Hatchery Evaluation Report and blank forms for additional comments. The following is the basic structure of the IHOT audit form:

Section 1 Performance Measures for General Information and Expenditure
Information (PMs General 1-2)

Integrated Hatchery Operations Team (IHOT) 1995. *Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries*, Bonneville Power Administration, Portland, Oregon.

Section 2	Performance Measures for Program Objectives (PMs 1-4)
Section 3	Performance Measures for Facility Requirements (PMs 5-15)
Section 4	Performance Measures for Hatchery Practices (PMs 16-25)
Section 5	Performance Measures for Fish Health Policy (PMs 26-34)
Section 6	Performance Measures for Ecological Interactions (PMs 35-38)
Section 7	Performance Measures for Genetics Policy (PMs 39-43)
Section 8	Blank Forms for Additional Comments.

Several performance measures are repeated in various sections of the audit form. These performance measures overlap in *IHOT 1995* and were retained to allow individuals interested in specific portions of the audit (such as Genetics or Fish Health) to determine the compliance status of all performance measures for a given topic in one location. A repeated performance measure is indicated by shaded text.

The Hatchery Audit Process

The hatchery audit will be conducted over a 2-year period that concludes in 1997. At each hatchery, a five-step process was used to complete the overall hatchery audit. This process consisted of research and onsite visits. The site visit at the Willard NFH was conducted on February 3, 1997.

The following is the five-step audit process:

1. Information was obtained from headquarters.
2. The hatchery manager was asked to fill out and return the **Audit Form**.

3. A 1-2 day site audit visit was conducted at each hatchery. During that visit an audit team inspected facilities, reviewed hatchery records, discussed audit form responses, and developed remedial action plans when appropriate.
4. During the site visit, the compliance status of each performance measure was discussed with the hatchery manager and IHOT representative. A portion of the Hatchery Evaluation Report was sent to the hatchery manager following the audit visit as a **Compliance Report**. That Compliance Report is Table 2 of this report.
5. Information from steps 1-4 was used to prepare a draft **Hatchery Evaluation Report**. This draft report was submitted to the operating agencies for review of the information used to determine compliance. Based on review and comments, a final Hatchery Evaluation Report was developed. The final report documents the compliance of a particular hatchery with the IHOT performance measures and presents cost estimates to correct any deficiencies.

Compliance Status of Willard NFH - Coho

The following table includes information on life-stages that are held on this facility for some portion of their rearing cycle (Table 1). For multi-facility programs, summary cost and contribution data is presented at the facility where rearing occurs. For the compliance status relating to performance measures that do not occur at this hatchery, please refer to the Hatchery Evaluation Reports for the hatcheries and stocks listed in Table 1. A check mark (4) indicates that the specific life-stage is held at this facility.

This section documents the compliance status of the Willard NFH - Coho program. Each performance measure is presented in a table taken from the audit form (Table 2). The compliance status is identified by the following categories:

- **N/A** (not applicable)
- **Yes** (in compliance)
- **?** (unknown; generally due to unavailability of information to determine compliance)
- **No** (not in compliance).

Remedial actions are suggested for performance measures not in compliance. These remedial actions are grouped into categories and listed in Section 4 of this report, where the cost of the required remedial actions is also presented.

Table 1 Summary Program Information for Willard NFH - Coho

Component	Location of Adult Holding, Spawning, Incubation, and Rearing					
	Little White Salmon NFH	Willard NFH				
Adult Collection	4					
Adult Holding	4					
Spawning	4					
Fertilization	4					
Incubation						
green-to-eyed	4					
eyed-to-hatch		4				
Rearing						
fry		4				
fingerlings		4				
smolts		4				
Acclimation/release		4				

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#1	Are the hatchery programs outlined in a subbasin management plan?		4			Columbia Basin System Planning Production Plan, Mitchell Act, and Columbia River Fishery Plan (NMFS)	
#2	Is the hatchery operating under a current hatchery operational plan? Is it understood by staff? Is it being followed?		4 4 4			IHOT Operations Plan	
#3	Is a hatchery monitoring and evaluation plan in place? Do you have a written monitoring and evaluation plan?		4			CWT and Missing Groups Report	
#4a	Adult contribution to fisheries, spawning grounds, and hatchery		4			Review of records	
#4b	Adult pre-spawning survival as compared with established goal	4				Spawning at Little White Salmon NFH	
#4c	Egg-take as compared with established hatchery goal	4				Spawning at Little White Salmon NFH	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
#4d	Green-egg to eyed-egg survival as compared with established goal	4				Incubation at Little White Salmon NFH	
#4e	Eyed-egg to fry survival as compared with established goal		4			Review of records; in compliance 4 out of last 4 years	
#4f	Fry to smolt survival as compared with established goal				4	Review of records; in compliance 4 out of last 5 years. Cold water disease causes problem.	Increase fry-to-smolt survival Also See PM #5a
#4g	Production as compared with established goal				4	Review of records; in compliance 1 out of last 3 years. Cold water disease causes problem.	Increase adult returns Also PM #5a
#4h	Percent survival (smolt to adult) as compared with established goal				4	Review of records; in compliance 2 out of last 4 years	Increase adult returns
#4i	Number of eggs, fry, fingerlings, smolts, and/or adults to meet basinwide needs	4				Review of records/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#5a	Temperature						
	Does your water temperature meet the criteria for spawning?	4				Spawning at Little White Salmon	
	Does your water temperature meet the criteria for incubation?		4			Review of records/Discussion	
	Does your water temperature meet the criteria for rearing?				4	Water too cold; cold water disease a real problem	Provide temperature control for rearing
#5b	Dissolved gases						
	Is the oxygen level near saturation?			4		Never been a problem	Monitor DO and record
	Is the dissolved nitrogen level less than saturation?			4		See above	Monitor TGP and record
#5c	Chemistry						
	Ammonia (un-ionized)			4		No current data	Run analysis
	Carbon Dioxide			4		See above	See above
	Chlorine			4		See above	See above
	pH		4			Review of records/Discussion	
	Copper		4			Review of records/Discussion	
	Hydrogen Sulfide			4		No current data	Run analysis
	Iron			4		See above	Run analysis
	Zinc				4	No problems observed	Run additional analysis and review Zn criteria

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
#5d	Turbidity						
	Does your turbidity meet the criteria?			4		Review of records/Discussion	Run analysis

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#5e	Alkalinity and hardness Does your alkalinity and hardness meet the criteria? Well River		4		4	Review of records/Discussion	Increase hardness of water
#5f	Nitrite Does your nitrite meet the criteria?			4		Review of records/Discussion	Run analysis
#5g	Contaminants Aldrin Endrin Dieldrin Heptachlor Chlordane Methoxychlor Lindane Malathion Guthion			4 4 4 4 4 4 4 4 4		No data See above See above See above See above See above See above See above	Run analysis for contaminants See above See above See above See above See above See above See above

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
#5h	Pathogens						
	What portions of the hatchery have disease-free water?						
	Adult holding	4				Adult holding at Little White Salmon	
	Incubation		4			Inspection of facilities/Discussion	
	Early rearing				4	Inspection of facilities/Discussion	Develop disease-free water supply for
	Rearing				4	Inspection of facilities/Discussion	early rearing
	Others	4					None

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#6	Alarm Systems						
	Do the following areas have alarms?						
	Intake		4			Inspection of facilities/Discussion	
	Large rearing ponds and adult holding ponds	4				None	
	Raceway headboxes and rearing ponds		4			Inspection of facilities/Discussion	
	Incubation facilities		4			Inspection of facilities/Discussion	
	Quarantine areas and facilities	4				None	
	Water treatment systems	4				None	
	Security				4	Inspection of facilities/Discussion	Install security alarms
	Are there outside systems and buzzers in onsite residences?		4			Discussion	
	Are water flow alarms checked daily?				4	Review of records/Discussion	Follow IHOT protocols for checking water flow alarms daily
	Are all other alarms checked weekly?				4	Review of records/Discussion	Follow IHOT protocols for checking other alarms weekly
	Is there a log of alarms for emergencies, tests, and maintenance requirements?		4			Review of records/Discussion	
	Are telephone pagers used?		4			Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
#7	Adult collection and holding facilities						
	Do you meet the adult holding criteria?	4				Adult holding at Little White Salmon	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#8	Incubation facilities						
	Type 1: <u>Vertical tray</u> Do you have an adequate number of units for the overall program?		4			Inspection of facilities/Discussion	
	Type 2: _____ Do you have an adequate number of units for the overall program?	4					
#9	Rearing facilities						
	Type 1: <u>Nursery tanks</u> Do you have an adequate number of units for the overall program?				4	Inspection of facilities/Discussion	Need additional nursery tanks
	Type 2: <u>Raceways</u> Do you have an adequate number of units for the overall program?		4			Inspection of facilities/Discussion	
	Type 3: _____ Do you have an adequate number of units for the overall program?		4			Inspection of facilities/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
#10	Screening facilities						
	Do you meet the approach velocity criteria?		4			Inspection of facilities/Discussion	
	Are the fish screens regularly cleaned?		4			Inspection of facilities/Discussion	
	Does the screen mesh meet screen opening criteria?		4			Inspection of facilities/Discussion	
	Are rearing containers double screened for fish that should not be released to adjacent water?	4				Released on station	
#11	Predator control facilities						
	Are your predation control facilities effective?				4	Inspection of facilities/Discussion	Install 1,100 ft of perimeter fencing and 41,700 sf of bird netting

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#12	Food storage facilities and quality control						
	Does the storage of dry/semi-moist/moist foods (dry<12%; semi-moist 12-20%; moist >20% moisture) follow food manufacturer's recommendations?		4			Inspection of facilities/Discussion	
	Does a regional quality control officer oversee production procedures and monitor:						
	Verification by feed manufacturer that ingredients meet specifications?		4			Discussion	
	Ensure feed does not contain unwanted drugs or other additives?		4			Discussion	
	Analyze ingredients contained in the final food product to ensure that feed specifications have been met?		4			Discussion	
	Are the foods stored and handled according to the following criteria?						

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
	Moist pellets should not exceed 10°F at point of delivery.		4			Discussion	
	Moist pellets should be removed from freezer just prior to feeding.		4			Discussion	
	Do not leave buckets of feed or feed containers outside exposed to light or heat.		4			Discussion	
	Open bags of feed should be fed within 1 to 2 days except when feeding small groups of fish.		4			Discussion	
	Automatic feeder hoppers and bulk storage facilities should be insulated against excessive temperatures (80°F and above).		4			Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#13	Release facilities Do the release facilities ensure that fish are not subjected to adverse conditions?		4			Inspection of facilities/Discussion	
#14	Pollution abatement facilities Do the pollution abatement facilities meet all federal and state regulations (or good engineering practice)? Are pollution abatement facilities operated correctly?		4 4			Inspection of facilities/Discussion Discussion	
#15	Transportation facilities Are the transport systems adequate to meet IHOT performance measures for transportation practices?	4				Only transport eggs	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#16	Broodstock selection practices						
	Is the donor selection process document attached? (PM #40a)	4				Existing program; does not apply	
	Was the donor selection outline followed in selecting the hatchery broodstock? (PM #40b-c)	4				Existing program; does not apply	
#17	Spawning practices						
	Were the appropriate number of spawners, male/female ratios, and fertilization protocols used? (PM #42c-g)	4				Spawning at Little White Salmon Hatchery	
#18	Incubation practices						
	Are specific incubation standards listed in the hatchery operations plan?				4	Reviewed IHOT Operations Plan	Develop specific incubation standards for the IHOT Operations Plan
	Are incubation practices written?				4	None supplied to inspection team	See above
	Incubation Type 1: <u>Vertical tray</u> (see PM #8) Do you meet the loading and flow criteria?				4	Review of records/Discussion	Follow IHOT incubation flow criteria or revise criteria

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
	Incubation Type 2: _____ (see PM #8) Do you meet the loading and flow criteria?	4				Review of records/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#19	Rearing practices						
	Are specific rearing standards listed in the hatchery operations plan?				4	Review IHOT Hatchery Operations Plan	Develop specific rearing standards for the IHOT Operations Plan
	Are rearing practices written?				4	See above	
	Rearing Unit Type 1: <u>Nursery tanks</u> (see PM #9)						
	Do you meet the density and DI criteria? Do you meet the Loading and FI criteria?		4		4	Review of records/Discussion Review of records/Discussion	Need 40 additional nursery tanks
	Rearing Unit Type 2: <u>Raceways</u> (see PM #9)						
	Do you meet the density and DI criteria? Do you meet the Loading and FI criteria?		4 4			Review of records/Discussion Review of records/Discussion	
	Rearing Unit Type 3: _____ (see PM #9)						
#20	Smolt quality						
	Do you produce a high quality smolt?		4			Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#21	Fish health management practices						
	Are the monthly hatchery monitoring visits being conducted? (PM #26)		4			Review of records/Discussion	
	Are the annual broodstock inspections being conducted? (PM #27)		4			Review of records/Discussion	
	Is there pathogen-free water (PM #5h)and are the sanitation procedures being followed? (PM #28)				4	Review of records/Discussion	See PM #5h
	Are the following water quality parameters within criteria? (PM #5a-5g)						
	Water temperature				4	Review of records/Discussion	See PM #5a
	Dissolved gases			4		Review of records/Discussion	See PM #5b
	Chemistry				4	Review of records/Discussion	See PM #5c
	Turbidity			4		Review of records/Discussion	See PM #5d
	Alkalinity and hardness				4	Review of records/Discussion	See PM #5e
	Nitrite			4		Review of records/Discussion	See PM #5f
	Contaminants			4		Review of records/Discussion	See PM #5g
	Are rearing standards being followed? (PM #19)				4	Review of records/Discussion	See PM #19

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
	Are egg and fish transfer/release requirements met? (PM #31)		4			Review of records/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#22a	Does hatchery performance meet requirements outlined in the regional hatchery policies and in subbasin and hatchery plans for the following areas?						
#22a1	Percent smoltification Do you measure percent smoltification? Do you have a smoltification goal Did you meet the smoltification criteria?			4	4	Discussion Discussion Discussion	Develop smoltification goal and monitor See above See above
#22a2	Rearing density (prior to release) Did you meet the rearing density criteria just prior to release?		4			Review of records/Discussion	
#22a3	Disease condition (at release) Did you meet all disease regulations just prior to release?		4			Review of records/Discussion	
#22a4	Number (at release) Did you meet the release number goal?				4	Review of records/Discussion	Increase adult returns
#22a5	Size at release Did you meet the size goal?		4			Review of records/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
#22a6	Dates of release						
	Did you meet the release date goal?		4			Review of records/Discussion	
#22a7	Location of release						
	Did you release the fish at the specified location?		4			Review of records/Discussion	
#22b	Are fish reared in the subbasin or acclimated in the subbasin?						
	Are the fish reared in the subbasin?		4			Discussion	
	Are the fish acclimated in the subbasin?		4			Discussion	
#22c	Is the release strategy appropriate for the program?		4			Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#23	Transportation facilities						
	Do transportation equipment and personnel receive disinfection before and after use?	4				No off-station transport of fish	
	Is the fish tank interior disinfected using a solution of 200 ppm active chlorine for 30 minutes minimum or formaldehyde gas generation method (relative humidity of 60% for 2 hrs)?	4				See above	
	Is the exterior of the fish transport vehicle disinfected using high pressure steam (115-130°C), high temperature acid, or with 200 ppm chlorine for 30 minutes?	4				See above	
	Is the fish transport vehicle (cab) disinfected using 600 ppm quaternary ammonia compounds (1.5 ml of 50% stock solution/liter water)?	4				See above	
	Is other equipment disinfected including fish pumps, nets, egg sorters, waders, boots, rain gear, hoses and other equipment using one of the following solutions?	4				See above	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
	200 ppm chlorine for 30 minutes 600 ppm quaternary ammonia compound for 30 minutes 200 ppm iodophor solution for 10 minutes	4					
	Do personnel wear protective garments when handling fish eggs or cultural water?	4				See above	
	Do the fish transport truck/chassis and tank/unit receive an inspection and service prior to the release season?	4				See above	
	Is a daily service inspection completed before starting up and leaving for the day?	4				See above	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#23 (cont)	Transportation facilities						
	Does the fish transport unit receive an inspection prior to loading?	4				No off-station transport of fish	
	Does a pre-loading inspection covering tank water level, pumps or aerators, oxygen injection system settings, displacement gauge, and truck loading/hauling density tables checked and reviewed occur prior to loading fish in the transport unit?	4				See above	
	Do hauling criteria include checking the fish 45 minutes to 1 hour after loading?	4				See above	
	When fish are active and systems are functioning properly, is the oxygen concentration reduced and maintained at approximately 8 ppm?	4				See above	
	Is water temperature in the transportation unit maintained within the 42-48 °F range?	4				See above	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
	Do fish releasing procedures include the following criteria?						
	Releasing the fish at the correct release site or into the correct water body.	4				See above	
	Tempering or the difference between the liberation tank and the target water body should not exceed 10°F.	4				See above	
	The liberation hose should be angled so that fish gently hit the water. Using a tripod is a method of ensuring the hose will stay at the proper angle.	4				See above	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#24	Evaluation practices						
	Has the hatchery conducted fishery contribution studies to:						
	Determine the requirements for evaluating and improving management programs?		4			Discussion	
	Develop guidelines that define the geographical area and identify component stocks (hatchery and/or wild) that comprise the management unit?		4			Discussion	
	Develop guidelines that define if the proper stocks of fish are currently being used?		4			Discussion	
	Determine which management units contribute to a specific fishery and the time periods of those contributions?		4			Discussion	
	Determine the relative contributions of the various management units to a specific fishery over the different time periods?		4			Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#25	Training practices						
	Does the hatchery have a training schedule for its staff?		4			Review of records/Discussion	
	Does each staff member have a personal training plan approved by a supervisor and reviewed annually?		4			Review of records/Discussion	
	Does the hatchery routinely exchange training details between other hatcheries and agencies?		4			Review of records/Discussion	
	Does the hatchery encourage and reward off-duty training of staff?		4			Review of records/Discussion	
	Does the hatchery conduct monthly staff meetings?		4			Review of records/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#26	Are monthly hatchery monitoring visits being conducted by a qualified fish health specialist as described below?						
	Conduct visit at least monthly		4			Review of records/Discussion	
	Monitoring conducted by qualified fish health specialist		4			Review of records/Discussion	
	Examine a representative sample of healthy and moribund fish from each lot.		4			Review of records/Discussion	
	Review fish culture practices with hatchery manager.		4			Review of records/Discussion	
	Report finding and results of necropsies on standard form.		4			Review of records/Discussion	
	Recommend appropriate drug or chemical treatment.		4			Review of records/Discussion	
	Summarize fish health status or stock prior to release or transfer to another facility.		4			Review of records/Discussion	
#27	Are all of the functions of the hatchery yearly monitoring visits being completed as described below?						

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
	Annually examine each broodstock for the presence of reportable viral pathogens.		4			Review of records/Discussion	
	Annually screen each salmon broodstock for the presence of <i>Renibacterium salmoninarum</i> .		4			Review of records/Discussion	
	Conduct inspection by or under the supervision of qualified fish health specialist.		4			Review of records/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#28	Is the hatchery following accepted sanitation procedures?						
	Are there any sources of pathogen-free water, especially for incubation and early rearing?				4	Discussion	Provide pathogen-free water for early rearing
	Are the hatchery sanitation procedures understood and being followed as described below?						
	Disinfect/water harden eggs in iodophor?		4			Inspection of facilities/Discussion	
	Are foot baths containing disinfectant placed at the incubation facility's entrance and exit?		4			Inspection of facilities/Discussion	
	Is equipment and rain gear utilized in broodstock handling or spawning sanitized prior to its use elsewhere in the hatchery?	4				Broodstock and spawning at Little White Salmon Hatchery	
	Is equipment used to collect dead fish sanitized prior its use in another pond and/or lot of fish?		4			Inspection of facilities/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
	Is equipment, including vehicles used to transfer fish between facilities, disinfected prior to use with any other fish lots or at any other location?	4				Transportation of eggs provided by Little White Salmon	
	Are rearing vessels sanitized after fish are removed and prior to introducing a new fish lot or stock?		4			Inspection of facilities/Discussion	
	Are dead fish properly disposed of?		4			Inspection of facilities/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#29	Are water quality parameters being followed?						
	Are the following water quality parameters within criteria? (PM #5a-5g)						
	Water temperature				4	Review of records/Discussion	See PM #5a
	Dissolved gases			4		Review of records/Discussion	See PM #5b
	Chemistry				4	Review of records/Discussion	See PM #5c
	Turbidity			4		Review of records/Discussion	See PM #5d
	Alkalinity and hardness				4	Review of records/Discussion	See PM #5e
	Nitrite			4		Review of records/Discussion	See PM #5f
	Contaminants			4		Review of records/Discussion	See PM #5g
	Go to PM #21						
#30	Are incubation and rearing standards being followed?						
	Are the incubation practices following the IHOT incubation criteria? (PM #18)				4	Review of records/Discussion	See PM #18
	Are the rearing practices following the IHOT criteria? (PM #19)				4	Review of records/Discussion	See PM #19
	Go to rearing practices PM #18-PM #19						
#31	Are egg and fish transfer/release requirements met?		4			Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#32	Is the hatchery's program outlined in a subbasin management plan? Go to subbasin plan PM #1		4			Columbia Basin System Planning Production Plan, Mitchell Act, and Columbia River Fishery Plan (NMFS)	
#33	Is the hatchery operating under a current hatchery operational plan? Go to operational plan PM #2		4			IHOT Operations Plan	
#34	Is a hatchery monitoring and evaluation plan in place? Go to hatchery monitoring and evaluation plan PM #3		4			CWT and Missing Groups Report	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#35	Does the hatchery program meet requirements established in the regional hatchery policies and subbasin planning documents in the following areas: species, stock, broodstock collection location, broodstock numbers, broodstock collection strategy, and spawning and egg-take protocols?						
	Does the hatchery program meet the requirements for the following?						
	Species protocols (PM #1)		4			Review of records/Discussion	
	Stock protocols (PM #1)		4			Review of records/Discussion	
	Broodstock collection location protocols (PM #41b for existing program; PM #39b for new program)	4				Broodstock and spawning at Little White Salmon Hatchery	
	Broodstock numbers protocols (PM #42c)	4				See above	
	Broodstock collection strategy protocols (PM #41b-d for existing program; PM 39b-f for new program)	4				See above	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
	Spawning protocols (PM #42d-e)	4				See above	
	Egg-take protocols (PM #42f-g)	4				See above	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#36	Does the hatchery's performance meet requirements outlined in the regional hatchery policies and in subbasin and hatchery plans for the following areas: percent smoltification, rearing density, disease condition, and the number, size date(s), and location of release?						
	Percent smoltification (PM #22a1)			4		Review of records/Discussion	See PM #22a1
	Rearing density (PM #22a2)		4			Review of records/Discussion	
	Disease condition (PM #22a3)		4			Review of records/Discussion	
	Number at release (PM #22a4)				4	Review of records/Discussion	See PM #22a4
	Size at release (PM #22a5)		4			Review of records/Discussion	
	Date of release (PM #22a6)		4			Review of records/Discussion	
	Location of release (PM #22a7)		4			Review of records/Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
#37	Are fish reared in the subbasin or acclimated in the subbasin? See PM #22b		4			Discussion	
#38	Is the release strategy appropriate for the program? See PM #22c		4			Discussion	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#39	For new programs, has a broodstock collection plan been developed?						
#39a	Is the broodstock collection plan written?	4				Existing Program; does not apply	
	For a non-captive broodstock program:	4				Existing Program; does not apply	
#39b	Was an unbiased, representative sample collected?						
#39c	Was the recommended number of broodstock collected?	4				Existing Program; does not apply	
	For a captive broodstock program:						
#39d	Were captive brood progeny excluded as donors for propagating the next generation of the captive broodstock program?	4				Existing Program; does not apply	
#39e	Were full-sib crosses avoided?	4				Existing Program; does not apply	
#39f	Is the broodstock collection plan understood and being followed by staff?	4				Existing Program; does not apply	

Table 2 Willard NFH - Coho Compliance With Performance Measures

		N/A	Yes	?	No		
#40	For a new program, was the donor selection outline followed in selecting the hatchery broodstock?						
#40a	Is a donor selection plan written?	4				Existing Program; does not apply	
#40b	Was the donor selection outline followed in selecting the broodstock?	4				Existing Program; does not apply	
#40c	Was the target stock recommended in the donor selection process actually used?	4				Existing Program; does not apply	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#41	For existing programs, were the broodstock collection procedures followed?						
#41a	Is the broodstock collection plan written?	4				Broodstock collection and holding at Little White Salmon Hatchery	
	Does the broodstock collection plan follow the guideline:						
#41b	Was an unbiased, representative sample collected?	4				See above	
#41c	Was the recommended number of broodstock collected?	4				See above	
#41d	Were the broodstock collection procedures in hatchery operation plan understood and followed?	4				See above	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#42	Was the appropriate number of spawners, male/female ratios, and fertilization protocols used?						
#42a	Are the spawning protocols written?	4				Spawning and fertilization at Little White Salmon Hatchery	
#42b	Are daily or weekly spawning logs available?	4				See above	
#42c	Was the appropriate number of spawners used?	4				See above	
#42d	Did you attempt to spawn all collected broodstock and randomize mating with respect to age class, and other traits?	4				See above	
#42e	Was the sex-ratio within the limits given in the performance standards?	4				See above	
#42f	Were the fertilization protocols followed?	4				See above	
#42g	If the hatchery needed to reduce the number of eggs retained, was this done by representative sampling of each male/female cross?	4				See above	

Table 2 Willard NFH - Coho Compliance With Performance Measures

PM #	Description of Performance Measure	Compliance Status				Basis for Compliance or Non-Compliance	Remedial Action Needed for Compliance
		N/A	Yes	?	No		
#43	Is there a genetics monitoring and evaluation program in place?						
	Is a genetics monitoring and evaluation program available?				4	None provided	Develop approved genetics M&E plan
	Does the plan address the following elements listed in IHOT:						
	Does the program have elements needed to meet evaluation goals 1-4?				4	See above	See above
	Has a qualified geneticist reviewed and endorsed the program (goal 5)?				4	See above	See above
	Will the program collect the data and maintain the records needed to evaluate compliance on an ongoing basis (goal 5)?				4	See above	See above
	Is the program understood and followed by staff?				4	See above	See above

Remedial Actions

Based on the compliance status for each performance measure, remedial actions were developed. The required remedial actions are organized into five categories. The types of categories range across a spectrum from those actions that are beyond human control, to those that require a change in agency policy or procedures, to those that involve a significant capital cost to put in place. The following are the five types of remedial actions identified under phase 1 of the audit:

The Five Types of Remedial Actions

Type	Description
1	Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery
2	Remedial actions requiring changes in agency policies or procedures
3	Remedial actions requiring changes in monitoring coverage or interval
4	Remedial actions requiring significant capital expenditures
5	Remedial actions that may require significant capital expenditures but are not clearly definable at this time

Remedial Actions at Willard NFH - Coho

This section presents the corrective actions required to bring the Willard NFH - Coho program into compliance with IHOT performance measures. The remedial actions suggested here are just that, suggestions developed by the Montgomery Watson Audit Team. For some non-compliance areas, other remedial actions could be proposed. The required remedial actions are cross-referenced to each IHOT performance measure that was not in compliance. Where appropriate, the costs associated with the remedial actions are also presented (Table 3).

The cost estimates presented in this section are based on professional experience from similar projects. In most cases, only a lump-sum figure is presented, and detailed take-off lists have not been prepared. The cost estimates are essentially order of magnitude estimates ($\pm 40\%$).

More importantly, the suggested remedial activities may also present several levels of action. Optional actions have been listed for several problems. These optional actions are desirable for either operational or safety considerations.

Table 3. Remedial Actions Required at Willard NFH - Coho

Remedial Action Required	Cost	PMS ¹
Type 1 - Non-compliance issues resulting from items beyond human control or Performance Measures not relevant for this hatchery Increase adult returns	----	4g, 4h, 22a4
Type 2 - Remedial actions requiring changes in agency policies or procedures Review IHOT temperature criteria Follow IHOT protocols for checking of flow and other alarms Install security alarms Develop specific incubation and rearing standards for the IHOT Operations Plan Follow IHOT incubation flow criteria or revise criteria Develop smoltification goal and monitor Develop approved genetics M&E plan	---- ---- ---- ----	5a 6 6 18-19 18 22a1 43
Type 3 - Remedial actions requiring changes in monitoring coverage or interval Monitor DO and TGP and record Run analysis for missing water chemistry parameters, turbidity, nitrite, and contaminants	---- ----	5b 5c, 5d, 5f, 5g

Remedial Action Required	Cost	PMS ²
Type 4 - Remedial actions requiring significant capital expenditures		
Provide temperature control for rearing	\$19.2 million	5a
Develop disease-free water supply for early rearing	\$15.0 million	5h, 28
Install 40 additional nursery tanks	\$850,000	9, 19,
Install 1,100 ft of perimeter fencing and 41,700 sf of bird netting	\$80,000	11
Type 5 - Remedial actions that may require significant capital expenditures but are not clearly definable at this time		
Increase fry-to-smolt survival	---	4f
Increase hardness of river water	---	5e

Hatchery Contribution to Fisheries, Spawning Grounds, and Hatcheries

This section presents the audit findings for the Willard NFH - Coho program contribution of adult fish to fisheries, local fisheries, spawning grounds, and hatcheries. Data is reported by broodyear. A broodyear refers to the adult contribution from the eggs produced from a single group of spawning adults. For some species, this may include fish caught as 2-, 3-, 4-, 5-, and 6-year old fish. Because of the return distribution and data processing delays, the complete adult contribution for a given broodyear may not be available until 4 to 5 years after the fish have been released from the hatchery.

**Table 4. Adult Contribution to Fisheries, Spawning Grounds, and Hatcheries:
Willard NFH - Coho**

Year	Fisheries (Broodyear)	Spawning Grounds¹ (Broodyear)	Hatchery¹ (Broodyear)	Total Combined Contribution (Broodyear)	Smolt to Adult Survival (percent)
1981					
1982					

Data obtained from Missing Production Groups Annual Report or from the Regional Mark Information System database.

Total combined adult contribution; presented when it is not possible to subdivide the contribution into fisheries, spawning grounds, and hatchery contributions.

1983					
1984					
1985					
1986					
1987					
1988	37,413	0	12,428	49,841	1.70
1989	6,199	0	2,210	8,400	0.32
1990	1,343	0	415	1,758	0.11
1991	552	0	1,657	2,209	0.072
1992					

Annual Operating Expenditures

The level and detail of annual operating expenditures varies widely depending on hatchery, operating agency, and funding source. When provided, expenditures were presented in terms of personnel costs, operating costs (power, feed, supplies), capital costs, indirect costs charged to the federal government, third-party costs, and other costs. These cost components were summed to determine a total hatchery annual cost. Based on discussion with the hatchery manager, the percent of total hatchery costs allocated to a given program was estimated. The total hatchery costs and the percent of hatchery costs allocated to a given program were used to compute the cost of a given program. Table 5 shows the annual operating expenses for the Willard NFH - Coho program. For programs that occur at more than one facility (as shown on Table 1 in Section 3 of this report), the cost breakdown for the component(s) at each facility is presented in separate tables (Table 5a).

Table 5. Annual Operating Expenses: Willard NFH - Coho

Hatchery	1993	1994	1995
1. Willard and Little White Salmon Hatcheries	\$357,787	\$496,272	\$434,599
2.			
3.			
4.			
5.			
Total Program Costs	\$357,787	\$496,272	\$434,599

The total expenditures for the Willard NFH are presented in Table 6 by program. The detailed breakdown of program expenditures at this hatchery are presented in separate tables (Table 6a).

Table 6. Annual Operating Expenses - Willard NFH

Program	1994	1995	1996
1. Coho (includes costs at Little While Salmon Hatchery)	\$357,787	\$496,272	\$434,599
2.			
3.			
4.			
5.			
Total Hatchery Costs	\$357,787	\$496,272	\$434,599

Table 5a. Annual Operating Expenses: Willard NFH - Coho

Expenditure Occurring at Willard and Little White Salmon Hatcheries

Component	1994	1995	1996
Personnel Costs	\$503,436	\$492,700	\$478,159
Operational Costs	\$304,210	\$358,975	\$384,141
Capital Costs			
Indirect Costs			
Lumped Hatchery Costs			
Lumped Third-Party Costs			
Total Hatchery Costs	\$807,646	\$851,675	\$862,300
Source of Funds			
NMFS	100%	100%	100%
Program Production (lb)	105,304	112,723	91,460
Total Production (lb)	237,747	204,728	181,600
Program as Percent of Total	44.3	55.1	50.4
Program Costs	\$357,787	\$496,272	\$434,599

When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.

Table 6a. Detailed Expenditures at Willard NFH by Program

Coho

Component	1994	1995	1996
Personnel Costs	\$503,436	\$492,700	\$478,159
Operational Costs	\$304,210	\$358,975	\$384,141
Capital Costs			
Indirect Costs			
Lumped Hatchery Costs			
Lumped Third-Party Costs			
Total Hatchery Costs	\$807,646	\$851,675	\$862,300
Source of Funds			
NMFS	100%	100%	100%
Program Production (lb)	105,304	112,723	91,460
Total Production (lb)	237,747	204,728	181,600
Program as Percent of Total	44.3	55.1	50.4
Program Costs	\$357,787	\$496,272	\$434,599

PMs are performance measures that were extracted from the IHOT 1995 report. The IHOT

When it was not possible to obtain a detailed cost breakdown from an agency or third party, the undivided costs were entered here.

performance measures are listed in Table 2 (Section 3 of this report) in numerical order.

PMs are performance measures that were extracted from the IHOT 1995 report. The IHOT performance measures are listed in Table 2 (Section 3 of this report) in numerical order.